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Editorial

Advanced materials for energy harvesting, storage, sensing and environmental engineering★

Mohamed El Jouad[1], Rachid Bennacer[2], Mohammed El Ganaoui[3], and Jean-Michel Nunzi[4,*]

[1] Chouaib Doukkali Univ El Jadida, Natl Sch Appl Sci, Sci Engineer Lab Energy LabSIPE, El Jadida, Morocco
[2] École Normale Superieure Paris-Saclay, CNRS, LMT, UMR 8535, 61 Ave President, 94235 Cachan, France
[3] Univ Lorraine, Lab Lermab, IUT Longwy, 186 Rue Lorraine, 54400 Longwy, France
[4] Queens Univ, Dept Chem, Dept Phys Engn Phys & Astron, Kingston, ON K7L 3N6, Canada

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Pioneering applications, original and unconventional approaches to materials science in the fields of advanced materials, energy recovery, storage, detection and environmental engineering required a new special issue of the journal. This is the result of a dialogue between two series of international conferences (notably ICOME 2017 and AETEEMS 2018). The objective of the latter was to provide an open forum to discuss progress in the field of materials for energy from production to storage. Participants were asked to share their views and experiences on this topic. Perspectives, points of view, techniques and methods were privileged, which brought new perspectives on intelligent applications, materials sciences, new technologies in the field of energy and environmental engineering and related fields. The strategic nature of the issues discussed at these meetings has generated promising scientific and socio-economic perspectives for the industry. This cognitive capital is part of the most recent indicators used at the international level to measure the development of states.

The present edition is a continuation of the three previous 2016, 2017 and 2018 editions [1–3]. It practically includes works on similar themes such as energy transfer and storage [4–6], materials for energy and photonics [7–10], solar thermal and photovoltaic [11,12]. The theme of sensors and the thermal and vibration energy harvesting using piezoelectric and pyroelectric effects received a particular attention [13–15].

Energy harvesting [16] consists in exploiting the sources present in our environment and converting them into a form of clean and exploitable energy. Renewable energies such as solar [17] and wind are also important sources of energy harvesting, but on a larger scale [18]. Advances in the field of nanotechnology include the creation of miniature and highly sensitive systems [19] to harvest small energy resources from the surroundings to operate small wireless sensors. Energy harvesting from these sources can be performed through many methods, such as electromagnetic induction, electrostatic generation, electrostriction, pyroelectric or piezoelectric materials. Energy recovery is used to power small devices, with the aim of making them energy efficient [20]. This makes it possible to reduce the use of wires to supply power, which facilitates their installation and eases their maintenance, because there is no more need to change batteries, or even allow more intense use, depending on the application [21].

We would not be able to talk about physics without using mathematics, even work in different areas of research and use different intellectual dispositions. This is proved by several works of researchers, and among them Einstein who said: "*How can it be that mathematics, being after all a product of human thought which is independent of experience, is so admirably appropriate to the objects of reality?*". In this perspective, this edition presents, in addition to the purely experimental component, numerical simulation works on physical phenomena, [22,23] that have benefited from advances in mathematical and material models.

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* e-mail: nunzijm@queensu.ca

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